PARENTAL CARE IN THE SALTWATER CROCODILE (*CROCODYLUS POROSUS* SCHNEIDER) AND MANAGEMENT IMPLICATIONS[1]

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Local people, who know these crocodiles' habitat intimately, are aware that *porosus* opens the nest, takes hatchlings into their mouths, and assume this as an act of cannibalism. The possible role of the mother taking threatened young in the water back into the mouth is discussed. The female in the water with her brood of approximately 25 young, close to her head is described. Three instances of human attack, two in 1978, by nest-guarding female *porosus* are described, and in all the three instances, the attack was not pursued and is considered as purely defensive of the area adjacent to the nest.

Introduction

Detailed reviews of parental care in crocodilians are given by Cott (1971) and Bustard (in press, a) with special reference to the Nile Crocodile (*C. niloticus*) and Indian crocodilians (*Gavialis gangeticus, Crocodylus palustris* and *C. porosus* respectively). The present paper, therefore, does not attempt to review the literature for species other than *C. porosus*. For accounts of parental care in general, the reader is referred to the review papers cited above.

Smith (1931) wrote of the female *porosus*, "She is said to remain in the vicinity until the young are hatched possibly to assist them to the water when they emerge from the shell".

This has now been confirmed.

C. porosus is now well-known to protect its mound nest Deraniyagala (1939); Cott (1971); Bustard (in press, a); Choudhury and Bustard (1979). Nest-guarding is usually carried out from specially constructed wallows adjacent to the nest (Deraniyagala 1939; Loveridge 1946; Choudhury and Bustard 1979). It is remarkable that Neill (1971) does not believe this species constructs wallows for nest-guarding, and that Webb *et al.* (1977) could write,

"It is not known whether *C. porosus* protects the nest against predators or not".

As pointed out by both Cott and Bustard (see, for instance, Cott 1971; Bustard, in press, b) behaviour of crocodiles has been much altered by massive human hunting activity. Nest-guarding females are particularly vulnerable (Bustard 1969, in press, b; Choudhury and Bustard 1979). This has resulted in the destruction of those females which guard the nest against humans, so that this trait—at least in as far as humans are concerned—is not now frequently exhibited. However, Bustard and Kar (in press) present recent data from Orissa, (see below for other recent instances) and there is no reason to believe

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that nest-guarding does not still continue against animals other than man. Cott (1971) documents several attacks directed against man by nest-guarding female *C. porosus*. It is noteworthy, however, that all occurred at least three decades ago, prior to the massive hunting phase which commenced in the post-war years.

According to our data the female crocodile does not remain at the nest throughout the incubation period but comes and goes from the river (Choudhury and Bustard 1979) along a path which may be well worn in the presence of grassy vegetation (Bustard unpub. obs.). The first quantitative study of nest-guarding, by a captive *C. porosus*, given by Bustard and Maharana (in press), demonstrates that absences from the nest, usually of short duration, are common place.

Pooley (1974) and Pooley and Gans (1976) have recorded female *C. nilotious* collecting newly hatched young, storing them in her gular throat pouch, then taking them to the water for liberation.

Webb *et al.* (1977) record nest opening by the female and state,

"Most hatchlings remained with the adult, grouped in a few square metres for up to and possibly more than two months after hatching."

C. porosus is, therefore, known to guard the nest, presumably to liberate the hatchlings and facilitate their reaching the water, and to stay with them for an extended period thereafter.

Materials and methods

The data presented here are based on discussions with people who have had a lifetime's experience with *C. porosus* when it was still abundant and had little contact with hunters. Such data cannot be obtained today. It is also based on personal observations where stated.

Results

Discussions with Australian aborigines:

One of us (H.R.B.) worked closely with Australian aborigines, particularly in North Queensland, but also in the Northern Territory and in Western Australia, in the late 1960's and early 1970's. On several occasions he was told quite adamantly by tribal aborigines, whose very survival depends on their acute powers of observation, that they had *personally* observed *C. porosus* taking the young into their mouth (they said "gobbling up the young"). This behaviour was cited as evidence of cannibalism. The informants were tribal elders, who had spent a lifetime observing nature.

At the time, while I doubted that a parent would eat its own young—as was inferred by an adult with a brood of young taking them into its mouth—I was unable to explain what they had obviously seen. It was not until A.C. Pooley told me that the mother *C. niloticus* collects the young in the gular throat pouch to take them to the water from the nest following hatching, that I realised what the aborigines had witnessed. They had witnessed females at the time of hatching, collecting the young as described by Pooley (1974), and Pooley and Gans (1976), and mistakenly deduced that the adult crocodile, presumbaly the mother, was in the act of eating her young.

I have also heard from the same informants that the adult crocodile may take the recent hatchlings into her mouth when they are in the water, that is some time after hatching. Again they assume that this is an act of cannibalism. Could it be that, suddenly suprised, the female gathers up a number of her brood to take them to safety? This suggestion may not be as far fetched as it sounds as is outlined below.

Discussion with an Oriyan crocodile hunter:

One of us (H.R.B.) talked to an old man, a former crocodile hunter, employed by the former Raja of Kanika in Bhitar Kanika the famous crocodile habitat in the Brahmini-Baitarani deltaic area of the Eastern Indian State of Orissa. His task was to keep a watch on people who purchased the right to shoot crocodiles from the Raja, in order to ensure they kept to the stipulated conditions. This informant gave me an eye-witness account of an event which happened over thirty years ago. He remembered it clearly, being interested in crocodiles, as it was the only time he ever observed this,

"I came upon a large crocodile one day when I was out in my dinghy and I noticed that there were a number of babies around its head. I paddled closer to have a good look. Before I could get very close the adult crocodile took the babies into its mouth and swam away."

If this account is to be believed—and there is no reason to doubt it, as the old man is only reporting what he saw with his own eyes —then it is a clear account of a female removing hatchlings, presumably recently hatched, from the scene of presumed danger, by taking them back into the gular throat pouch.

Discussions with a crocodile hunter in the Andaman Islands:

While carrying out field work relating to nest location and nesting ecology on North Andaman Island in 1978, one of us (B.C.C.) employed as guides, persons with at least several years experience in crocodile hunting. One of these guides had migrated to India from what is now Bangladesh in the late 1940's. He operated as professional saltwater crocodile hunter first in Sunderbans (West Bengal), then in the Bhitar Kanika area of Orissa and later with the East Bengal refugee settlement he went to the Andamans where he continued crocodile hunting. This informant, aged about 50 years, has an intimate knowledge of saltwater crocodiles having observed them in all three of their surviving Indian habitats. In a discussion of the ease with which nest-guarding females can be killed, he confirmed that he had been charged at by many nest-guarding female saltwater crocodiles.

This informant has also observed nest hatching in nature. He informed that the mother supervises the whole operation of opening the nest and allowing the hatchlings to emerge from the egg this fits in perfectly with Pooley's (1974) observations and those of other recent authors (see Bustard, in press a and b) for other species and then eats them up, one after the other. It would appear that this informant has observed the female collecting the young to take them to the water as described by Pooley (1974). He further stated that only those hatchlings which come out from the side of the nest mound away from the parent crocodile survive, and he believes that this is one reason why so few young crocodiles are seen.

Observation of C. porosus with young in Andamans:

On 13 July 1978, while searching for nests along one of the (unnamed) creeks on the West coast of North Andaman, one of us (B.C.C.) saw a 2.7 m crocodile, presumably a female, with its brood of approximately 25 hatchlings. The head region of the creeks in this area show an alternation of small rapids and deep pools, the latter particularly on sharp bends. The group was located in such a deep pool below a rapid. These pools always have overhanging vegetation on the deep water side.

The young, with the parent crocodile, were observed at about 4.30 p.m. on a very cloudy, drizzling day with poor visibility. The head of

the mother crocodile and the hatchling group could be discerned but conditions did not permit photography. All the hatchlings were within a distance of 10 m. One of the guides who had gone ahead to the other bank in the meanwhile came into view, and being disturbed, the mother sub-merged first, followed immediately thereafter by the hatchlings. Most of the hatchlings were very close to the mother's head rather than to the tail.

Active defence of the nest against man:

Case History 1

During the 1978 nesting season in North Andaman, a case of human attack by a nest-guarding female was recorded. On 22nd June 1978 while searching for nests, in the Laxmipur nullah, a tributary of the Kalpang River on the East coast of North Andaman, a crocodile was observed by one of us (B.C.C.) in the stream. A robbed crocodile nest was located very nearby. Two old ladies were fishing with rods on the bank of this stream. Before leaving the place the old ladies were warned about the presence of a nest-guarding crocodile in the water nearby.

One of the old ladies, aged about 45-50 years, had been attacked by a nest-guarding female crocodile, possibly the same one, at the same spot during 1976, yet seemed not to heed the warning. The crocodile had bitten her on the buttocks and a portion of the flesh of this region was subsequently removed when she was hospitalised. At the time of attack she was standing in water of approximately three feet depth in the bed of the river, at low tide, fishing with a cloth scoop.

Four days later, on 26 June 1978 returning to that area it was learned that the same lady had been attacked by the crocodile again that morning. On enquiry it was learned that during the low tide, the ladies were again using scoop nets in the stream and while doing so one of them was attacked by the crocodile. She was rescued by the other lady but one of her hands was subsequently amputated in hospital, the crocodile having grabbed her by the left wrist.

The nearby nest being located on hard ground, did not have a wallow, and presumably the mother crocodile was using the adjacent portion of the stream for nest-guarding purposes.

Case History 2

During the 1978 nesting season a second case of human attack by a nest-guarding female was recorded in North Andaman, in a creek near Kishorinagar village on the West coast. A boy, aged about 12 years, was attacked by a crocodile while taking his bath, along with a group of boys. The attack was not severe, consisting only of a small injury at the shoulder region.

Some days later the female was killed by the villagers by the nest which was also robbed. The female measured 2.6 m. The nest-site, checked later, had only one wallow but the permanent water in the stream was hardly 5 m away. Clearly, as in the instance cited above, the female was watching the nest part of the time from the stream.

Discussion

In the cases of human attack recorded above by nest-guarding females, it is noteworthy that only minor damage was sustained. This is thought to reflect not the assistance of another old lady on two of the occasions or other boys on the third occasion, but the fact that these attacks were purely defensive—by the nest-guarding female against a person or persons coming too close to the nest. Food is abundant and few attacks on humans are recorded in the Andamans. It is likely that further in-

vestigation of the latter would indicate that many/most of them were occasioned by nest-guarding females. These data are in agreement with the discussion which one of us (H.R.B.) held with A. C. Pooley in 1973 in which Pooley informed that most attacks on humans by *C. niloticus* investigated by him could be attributed to nest-guarding females.

The present eye-witness accounts confirm the actual opening of the nests by the adult crocodile, implicitly inferred to take place by Webb *et al.* (1977) but not actually observed for this species but observed in other crocodiles, (Pooley 1974). These data also provide further evidence of the mother remaining with the hatchling brood, also described by Webb *et al.*

The accounts of the tribal aborigines and that of the Oriyan crocodile hunter also suggest that in the wild the adult crocodile may take the recent hatchlings back into the gular throat pouch if danger threatens.

It is not suggested that parental care is able to protect all the hatchlings effectively. In the murky water inhabited by *C. porosus* an aquatic predator can approach undetected and predation takes only a fraction of a second. Furthermore, the large number of hatchlings makes any attempt at individual attention—as could be possible, were there one or at the most two hatchlings—impossible. At least some recent hatchlings occur scattered in nature (Bustard, unpubl. obs., S. Kar pers. comm.) and these have clearly left the hatchling group as noted by Webb *et al.* (1977), who also present preliminary post-hatching movement data.

Data available, however, shed no light on the percentage survival of young which remain with the parental group as compared to those which leave it. Quantitative data on this aspect of parental care are required before any concrete assessment of the advantages of post-hatching parental care can be made. At the present time it can be merely assumed that factors which tend to keep the hatching group together, and closely associated with the head of the mother, have enhanced survival value.

In management of this species it is standard practice in the Government of India Project, on the technical advice of the senior author, to collect all eggs of *C. porosus*, as soon as laid for safe hatchery incubation. All hatchlings are also captive reared to a length of 1.20 m before being 'seeded out' into the wild habitat. There can be no question that this technique enhances survival many-fold under conditions where a substantial level of flooded nests occur—over which the female has no control (the situation in much of Northern Australia), or where human interference with the nest (egg-robbing) is widespread as in parts of India. For instance Webb *et al.* (1977) record an 80% nest loss through flooding alone, and Choudhury and Bustard (1979), a 93.4% nest loss through predation (73.3% due to human agency) with only 3.3% of nests in nature hatching in 1978.

It would be difficult to imagine a natural situation where hatching survival would not be enhanced by collection of freshly-laid eggs, provided, of course, that proper methods of egg handling are used by trained operatives, and a predator-proof hatchery, offering the required micro-environmental parameters of temperature and humidity, available for incubation. Furthermore, hazards such as killing of the nest-guarding female, whose eggs are then extremely vulnerable and the enhanced predation risk when the female is absent from the nest (Bustard 1975) are further factors favouring egg collection for hatchling incubation.

Similarly, a restocking station fed with

freshly hatched young should be able to increase the production of 1.20 m crocodiles to many times the number surviving at this size/age in nature. Although predation is an extremely difficult thing to observe in nature there are many hatchling predators recorded (see, Cott 1971) and many other potential predators.

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